Lecture [big session]

13 December 2015 11:14 AM

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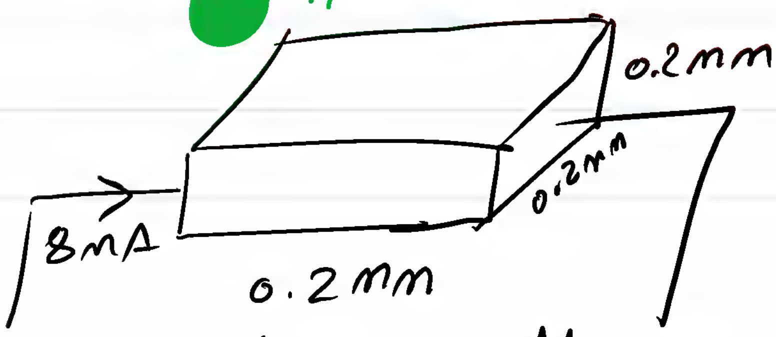
solution
another solution
note

sheet 9



1 Volt

$\mu_n = 1400$

$n = ??$

$V_d = ??$

9)

$$R = \frac{V}{I} =$$

$$R = \frac{\rho l}{A} \rightsquigarrow \rho = \frac{RA}{L} =$$

$$\sigma = \frac{1}{\rho} = q n \mu_e$$

$$n = \frac{\sigma}{q \mu_e}$$

$$J = I/A = q n \mu_e V_d$$

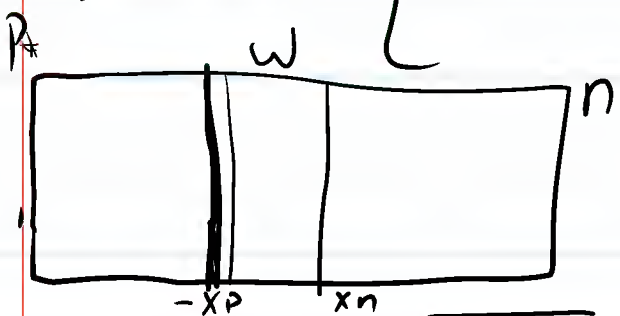
$$E = V/L$$

$$V_d = \mu E$$

$$J = I/A = q n \mu_e V_d$$

10)

$$X_n = \left[\frac{2 \varepsilon_s (V_{bi} + V_R)}{q} \left[\frac{N_A}{N_D}\right] \frac{1}{N_A + N_D} \right]^{1/2}$$



$p^+ n$: P is Heavily doped

$$W = \sqrt{\frac{2\varepsilon (V_0 + V_R)}{q N_D}}$$

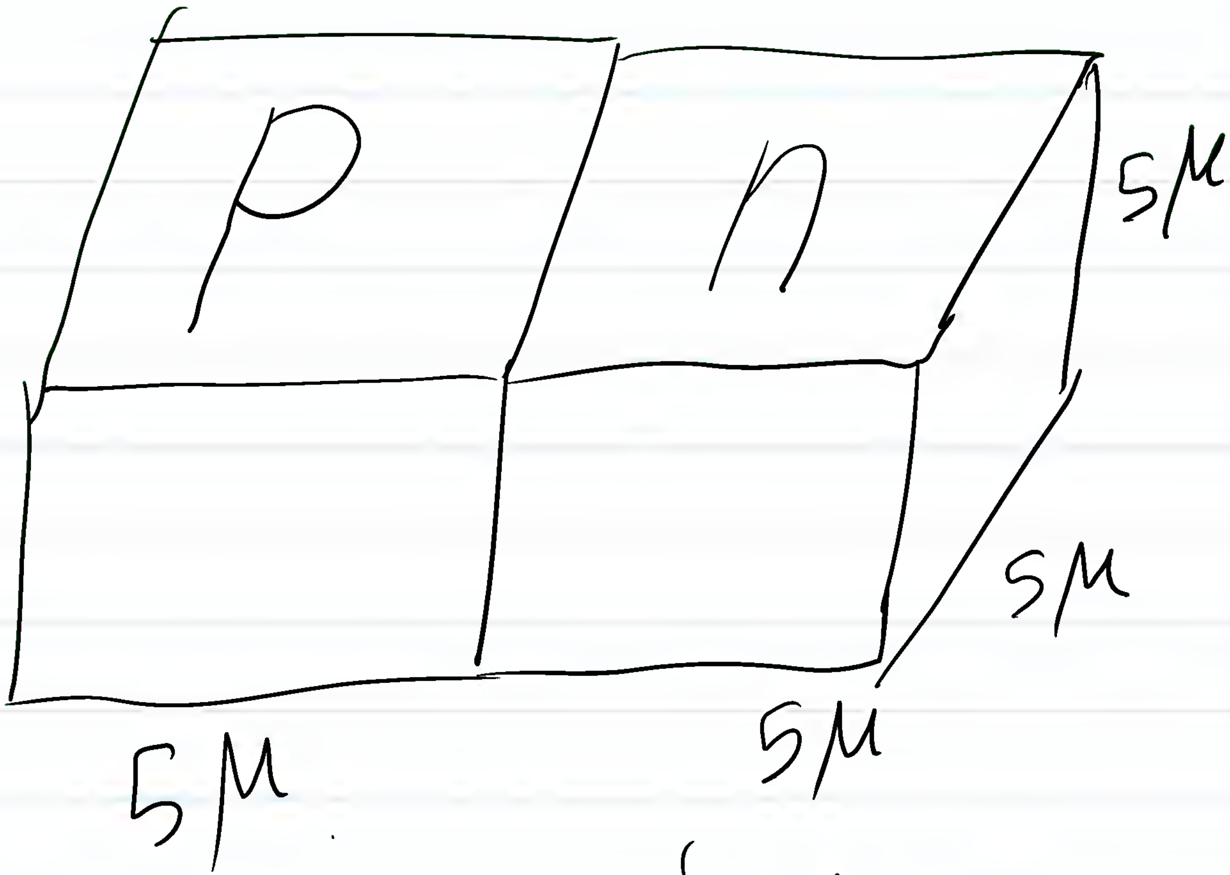
$$C' = \frac{\varepsilon}{W} = \sqrt{\frac{\varepsilon q N_D}{2(V_0 + V_R)}}$$

$$\left(\frac{1}{C'}\right)^2 = \frac{2(V_0 + V_R)}{A^2 \varepsilon q N_D} =$$

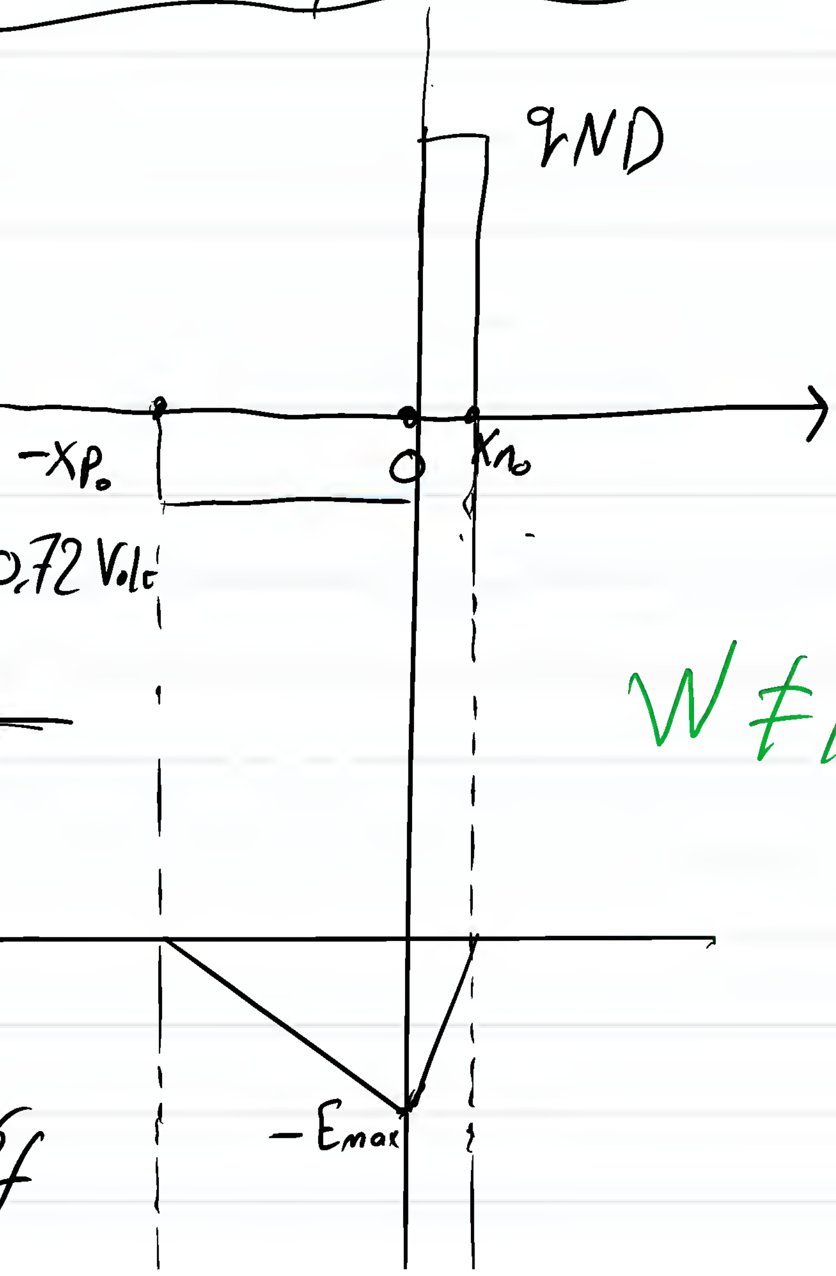
$2 \quad V_R \quad . \quad 2V_0$

$$= \frac{2}{A^2 \varepsilon q N_D} V_R + \frac{2V_0}{A^2 \varepsilon q N_D}$$

11)



$P = N_A = 10^{14}$	$\mu_p = 400$	$\mu_n = 2000$
$n = N_D = 10^{18}$	$\mu_p = 300$	$\mu_n = 800$



$$V_0 = \frac{KT}{q} \ln \frac{N_A N_D}{n_i^2} = 0.72 \text{ Volt}$$

$$W = \sqrt{\frac{2\varepsilon V_0}{q}\left[\frac{1}{N_D} + \frac{1}{N_A}\right]}$$

$$= 3.05 \ \mu m$$

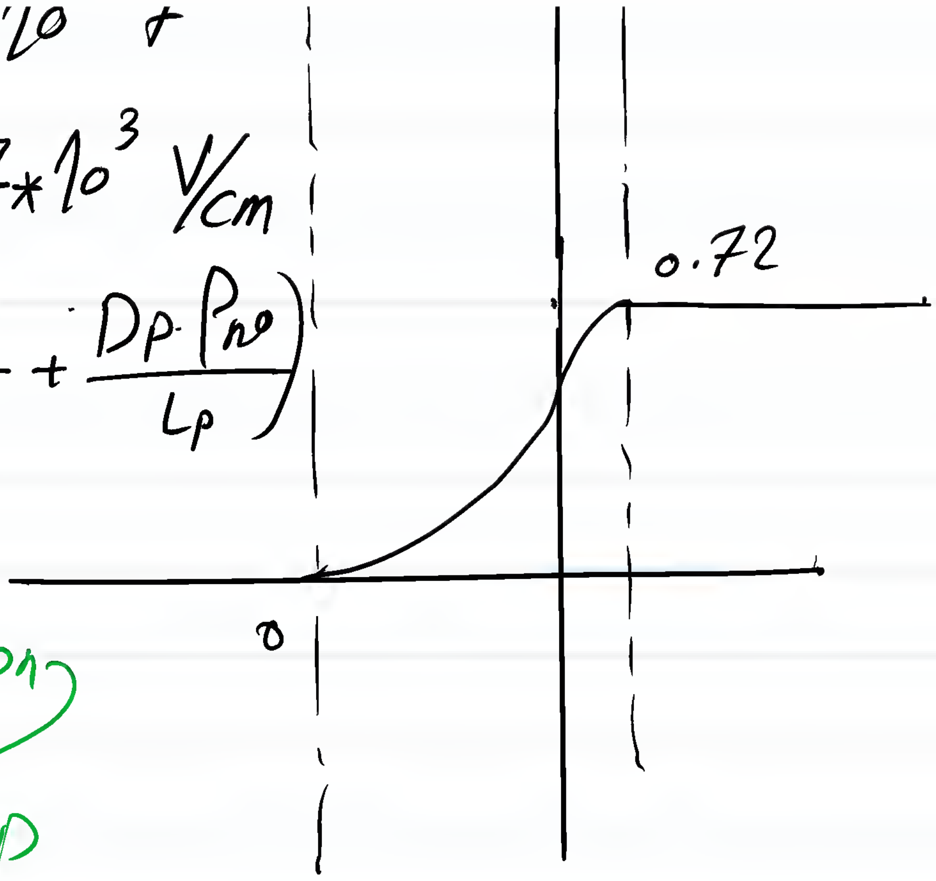
$W \neq 10 \mu m$

$$C = \frac{\varepsilon A}{W} = 8.49 * 10^{-16} f$$

$$C = \frac{\epsilon A}{W} = 8.15 \times 10^{-}\ F$$

$$\mathcal{E}_{max} = \frac{-2V_o}{W} = -4.7 \times 10^3\ V/cm$$

$$I_o = Aq\left(\frac{D_n n_{po}}{L_n} + \frac{D_p P_{no}}{L_p}\right)$$



$D_n \rightarrow P$ Region use μ_n of P

$D_p \rightarrow n$ Region ~ use μ_p of n

$$D_n = \mu_n\left(\frac{KT}{q}\right) = 26$$ Enisten Relation

$$D_p = \mu_p\left(\frac{KT}{q}\right) = 7.8$$

$$I_o = Aq\left[\sqrt{\frac{D_n}{\tau_n}} \cdot \frac{n_i^2}{N_A} + \sqrt{\frac{D_p}{\tau_p}} \cdot \frac{n_i^2}{N_D}\right) = -4.11 \times 10^{-10} A$$

$$I_R = -I_o$$

$$I_f = I_o\left(e^{V_f/(KT/q)} - 1\right)$$

$$= I_o\left(e^{0.4/0.0259} - 1\right) = 1.97\ mA$$

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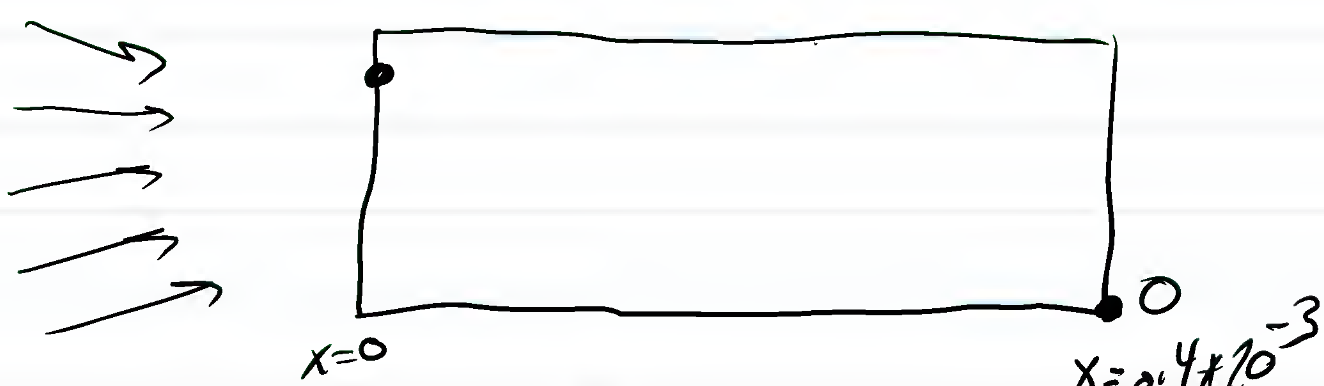
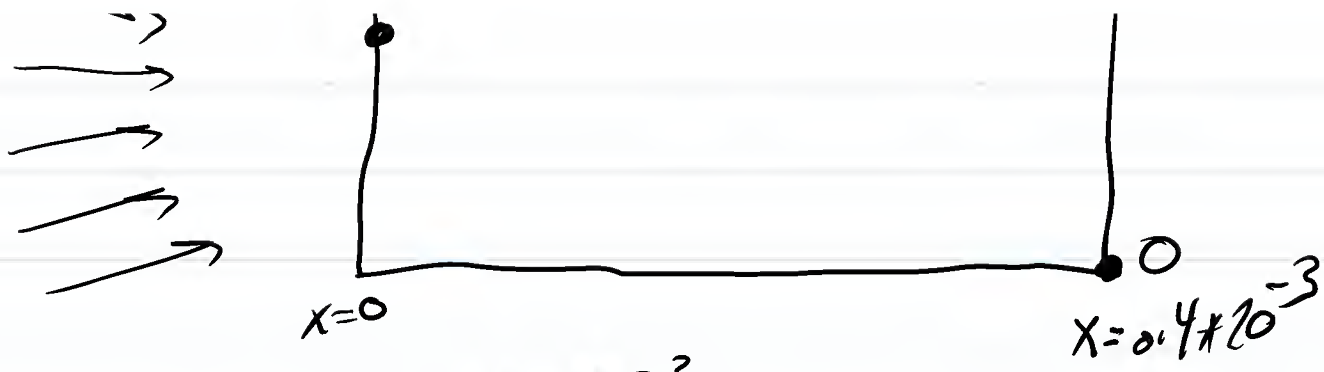
12)

$$\Delta P = \Delta n = 10^{12}\ cm^{-3}$$





$L_p = 0.4 * 10^{-3}$ cm

use $e^{x} = 1 + x$

$x << 1$

$$e^{x} = 1 + \frac{x}{1!} + \frac{x^2}{2!}$$

$$D_p \frac{\partial^2 \Delta P}{\partial x^2} - \mu_p E \frac{\partial \Delta P}{\partial x}$$